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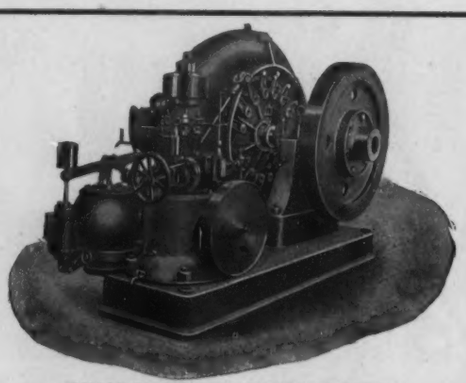

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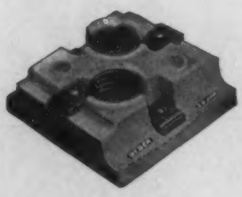

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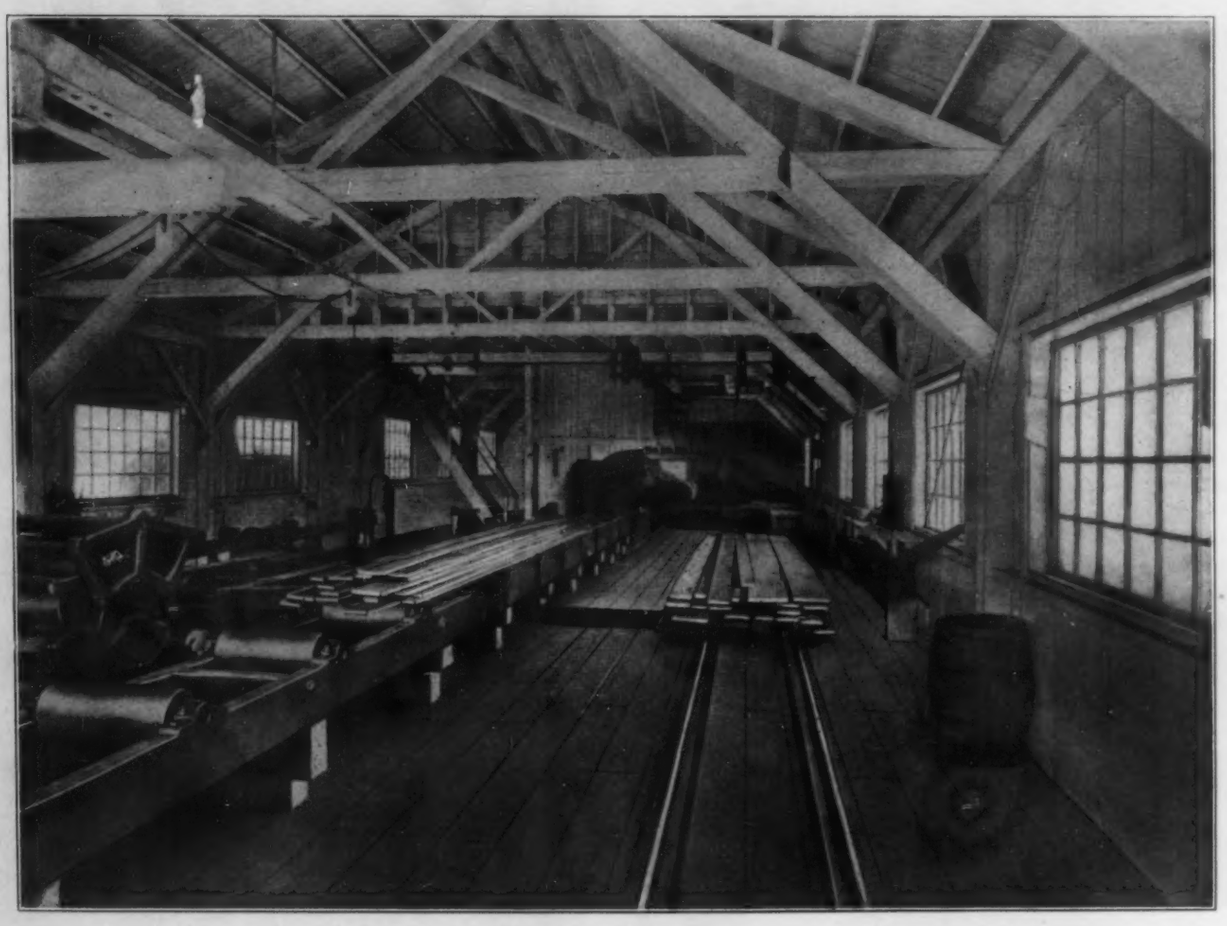
ELECTRIC DRIVE IN SAWMILLS

BY C. REMSCHEL.

The modern manufacturer, the man who is after results, is quickly beginning to realize the advantages of the electric drive and it is therefore no wonder that some of the most progressive sawmill men of this country have adopted the electric drive and others are contemplating doing so. At a first glance, it would seem absurd to the average person that an electric drive in a sawmill would have any advantage over the old method of steam drive, taking into consideration the amount of refuse timber going to waste in every sawmill each day, and which of course apparently looks as if economy were no object. This, however, is wrong, as you will very shortly see.

Most large mills are distributed over a large area, as are also the various machines employed in a mill; consequently considerable transmission machinery is required to get power to all of these machines. In order to properly compare the electric drive with that of steam, it is natural that the first cost or the complete cost of the installation be compared. Experience has taught us that the first cost of both is about



Electric Drive on the Sawing Floor.

[1]Paper read before Seattle Section, A. I. E. E.

the same, where everything is taken into consideration.

As before mentioned, a great deal of transmission machinery is required in the average mill, and the friction load varies from 40 per cent to 60 per cent of the total power required by the mill. A great deal of this friction is saved by electric drive, and consequently the capacity of the power plant of an electrically operated mill need not be as large as in a steam driven mill, which means that there will be fewer boilers required, as well as a smaller engine. This will offset the additional cost of the generator and switch-board. The cost of the motors and their installation also offsets the cost of the transmission machinery and the cost of its erection. With electric drive, also the power plant, which is by far the most valuable machinery in a mill, can be placed beyond danger from fire. Lights can be operated from the same generator that furnishes power for the motors, thereby saving the cost of the separate lighting plant. Another advantage is the absence of transmission machinery in a well designed electric driven mill, which means that

Induction Motor Log Haul.

the lower floor of the mill is more open, of easy access and offers less chance of workmen being hurt. There is also less danger of shut downs, as there is practically nothing to get out of order. In the average mill, it takes at least one wright continually keeping transmission machinery in repair. This would almost be entirely eliminated. It also keeps one man lubricating, which is done away with, as motors need attention infrequently, and are not so extravagant in the use of oil. In a medium sized mill, the cost of lubricants amounts to several hundred dollars per year. Another advantage is that most all sawmills sooner or later install a planing mill, which has to be located some distance from the main mill, and it is much easier to get power to it over a wire than through a steam pipe. Furthermore, it does away with an additional engineer, if an engine were installed in the planing mill. In case of a breakdown in some part of the mill, it is not always necessary to shut down the whole plant to make immediate repairs, as is generally the case in a steam driven mill.

Besides the advantages mentioned, there are many others too numerous to mention here. It is very easy to make a mistake in figuring out the proper size and kind of motor to use for the work intended. It is therefore advisable to leave the selection of the electrical apparatus in the hands of an engineer or some one familiar with both electrical and sawmill machinery.

The following is an approximate statement of power required to drive the various machines in a sawmill, and the best method of connecting them.

Log Haul. The horsepower required by a log haul depends entirely upon the length and angle of same, as well as the speed at which the logs travel, and the size of logs to be handled. The maximum horsepower required does not generally exceed 30 h. p., while the minimum for the smaller ones, 15 h. p. Owing to the logs being started and stopped very frequently, it is advisable to belt the motor to a friction clutch pulley on the log haul, and run the motor continuously—starting and stopping the logs by means of the friction clutch.

Band Mill. The horsepower required by a band mill varies from 100 h. p. for the 6 ft. band to 400 h. p. for the 11 ft. band mill. Owing to the heavy weight of the wheels of a band mill, a large amount of power is required to start it, and consequently a motor having a large starting torque is recommended, and where the generating capacity is rather small to the motor load, a motor with a wire wound rotor is necessary. Owing to the speed of a band mill and its general design, it is rather difficult to arrange the motor for direct connection, and it is therefore recommended to belt the motor to the band mill.

Circular Saw. The power required by a circular saw is a great deal more than required by a band mill. When cutting at the same speed, this is due to the fact that while the average cut of the saw on the band mill is about 3/8-in., on the circular it is about 3/8 to 1/2 in. Therefore the power required and recommended for a circular varies from 250 h. p. for the smaller, to say 400 h. p. for the larger, or 66 in. saws, unless the saw has a fly wheel, and on smaller motors, a standard squirrel cage induction motor is recommended. Otherwise a wire wound rotor motor would be the best. As in the case of the band mill, it is preferable to belt the motor, except in a case where the speed of the saw arbor is such that the motor can be direct connected.

Edger. The size of the edger varies so much that it is hard to state the size motor to recommend, unless it is known what size timber is to be edged. However, the size varies from 50 h. p. for the smaller ones to 150 h. p. for the larger ones, namely: 11 in. x 84 in., owing to the high speed. It is not advisable to direct connect the motor to the edger. A standard squirrel cage induction motor is best suited for this class of work.

Slasher. A 10-saw slasher requires 30 h. p. to operate. As the speed is such that a motor can be direct connected, it is recommended to direct connect the motor by means of a flexible coupling. A standard squirrel cage motor is satisfactory for this work.

Trimmer. A 20 saw trimmer requires a 40 h. p. motor. Owing to the speed, it is rather difficult to direct connect the motor. It is therefore recommended

to belt it. A standard squirrel cage induction motor is best suited for this work.

Resaw. The horsepower of a resaw varies as to the size of resaws from 40 h. p. for 54 in. to 100 h. p. for 84 in. Wherever the speed makes it permissable, it is recommended to direct connect the motor. The standard motor of the squirrel cage induction type is recommended for this work.

Live Rolls and Transfers. The horsepower required by these is very hard to state, unless the exact conditions that they are to operate under is known. However, very little power is required and a standard squirrel cage induction motor is best suited for this work. These motors are generally belted as two or more sections are groups driven by one motor.

Electrically Driven Edger.

Conveyors. The horsepower of conveyors depends entirely upon their length and their angle, as well as the speed at which they travel. The horsepower very seldom exceeds 15 h. p. for the longest and largest of conveyors. This should also be a standard squirrel cage motor and should be belted, owing to the speed.

Sorting Table. Here again it is pretty hard to state just exactly what size motor is required, as the size depends upon the length and width of table and the rate of travel. However, the horsepower is generally from 15 to 20 h. p. for each 50 ft. of length in sorting table. This motor should be belted and of the standard squirrel cage type.

Lath Mill. The machinery for the lath mill generally consists of one small and one large mill, including a trimmer. The horsepower required depends entirely upon the size of machine. These machines should all be driven from one motor belted to a short line shaft.

Shingle Mill. Shingle mill generally consists of several machines and as in the lath mill, the horsepower required depends upon the size and number of machines installed, and it is recommended to group drive these machines from one motor driving into a short counter shaft. A standard squirrel cage induction motor is best suited for this work.

Filling Room. The horsepower required by a filling room varies from 5 to 15 h. p. depending entirely upon the amount of work to be handled. The machines should be group driven and operated by a single squirrel cage induction motor.

Besides the motors mentioned there are quite a number of machines in a sawmill which are operated by steam cylinders, which of course will remain the same, with the exception of mills that are operated by Hydro-electric plants. In such cases, it is necessary to either install a boiler to operate these cylinders, or a motor driven compressor; the latter being preferable.

Standard speed motors should be used wherever possible, for the reason that in case of an accident, it is much easier to get a standard speed motor out of stock than a special speed motor.

ELECTRICITY ON THE MAURETANIA.

A writer in the Electrical Review of London gives an interesting account of the important parts played by electricity in developing the great speed attained by the Mauretania. He says:

"Without in any way reflecting upon the abilities of the engineers, it must be admitted that they did not seem to have grasped the great possibilities of the various auxiliaries on the ship; and it is attention to these auxiliaries which determines the ultimate fulfillment of the designers' ideas.

"As is now well known, practically all the auxiliary machinery on the Mauretania is electrically driven, * * * and it is equally well known, especially among electrical engineers connected with shipwork, that marine engineers have a stubborn and conservative objection to anything other than the steam-driven plant with which they have been brought up. When, therefore, an electrical installation of more than 2000 horsepower was thrust upon them with practically no qualified electricians on board to enlighten them as to its proper usage, they naturally felt some trepidation, and had little desire to attempt any record speeds.

"Perhaps it is not quite evident why the speed of the ship should entirely depend on the auxiliary plant, and in explanation it must be said that practically all fast boats require a relatively enormous quantity of steam at high pressure, which can only be obtained from the boilers when high-power forced-draft fans are employed to supply air to the furnaces, and a slight diminution in their output has an immediate effect on the steam pressure of the boilers, and consequently on the speed of the engines and propellers. In the case of the Mauretania the forced-draft fans are electrically driven."

"It is strange, on the face of it, that such apparently small details should be the means of converting a twenty-three-knot boat into one of twenty-six knots; but it is no exaggeration to say that the records of the Mauretania are entirely due to a better understanding of the electrical conditions."

THE SLIDE RULE AS A SUBSTITUTE FOR THE WIRING TABLE.

BY GEORGE COOLEY.[1]

The usefulness of the slide rule to the wireman and the mechanic to facilitate the working of problems is becoming appreciated by those who seek quick methods for arriving at results which require more or less figuring and the presence of tables and formulas. The slide rule is generally considered as an instrument only for the engineer or mathematician to be used in the more complicated calculations, and its use as both tedious and difficult. While its construction is based upon logarithms, a knowledge of them it is not necessary. By studying the directions that come with the rule, and practicing at odd times, any one with an ordinary knowledge of arithmetic, can soon become very expert with the rule.

The following information is intended for the wireman; it is a substitute for the wire table, and while not as accurate it is sufficient for all ordinary purposes. American or B. & S. gauge sizes are considered and resistance as calculated for 20 degrees Centigrade. In order to facilitate reading, sizes 00, 000, and 0000 are called -9, -8 and -7, respectively.

The resistance of 1000 ft. of copper wire may readily be found from its gauge size by the method suggested by Mr. Sakai in the October, 1905, Electric Journal, as follows: Divide the size number by 10, calling the integral part the characteristic and the decimal fraction the mantissa. Place the mantissa on the L scale over the right index on the back of the rule. Turn the rule face up and read the resistance on D under the index on C, pointing off a number of integral places equal to the characteristic. From the above, the resistance of 0000 (-7), the reading is .0502 which is practically correct for 20 degrees C. for No. 36 the reading is 398.2, the correct reading being 414.2, or about 4 per cent too low. As intermediate sizes are represented by a straight line they can be calculated with a fair degree of accuracy. In volume 47, page 459 of the Electrical World, Mr. Carl P. Nacod describes the following method of finding the resistance per 1000 ft. when the diameter is given. Place the diameter of the wire on the C scale over 102 on the D scale and the resistance will be found on the A scale over the index of the B scale. The results obtained are practically correct for 20 degrees C. or as accurate as is consistent with slide rule practice. In Mr. Sakai's method the resistance is found from the gauge number and in Mr. Nacod's method from the diameter.

A very convenient method for finding diameters from gauge sizes and vice versa is given by Mr. Otto E. Falch, Jr., in Vol. L, page 228 of the Electrical World. On the top edge of the rule is a scale divided off into inches, 10 inches long. Considering the 8-in. mark as corresponding to No. 0 wire and each ¼-in. division to the left as the gauge size next smaller and to the right as the gauge size next larger, then the 7-in. mark would represent No. 4, the 6-in. mark No. 8, and so on to the 1-in. mark which would represent No. 28. Then going to the other end of the rule call the 10-in. mark No. 32, the 9-in. mark No. 36 and the 8-in. mark again No. 40. Now place the runner on the diameter of No. 10 wire, in mils on the A scale, which is 102. The 5½-in. marks represents No. 10 size. Scratch a line on the runner to correspond with the mark, calling it N. By placing N on the division of inches representing any gauge size, its diameter will be found in mils under the index of the runner on the A scale. The A_1 index is considered as 10 the A_2 index as 100, or 1 where sizes 32 and smaller are considered, and the decimal point placed accordingly.

By reversing the slide with the figures of the L scale right side up, the mantissa of the gauge number can be placed to correspond with either index and the resistance per 1000 ft. read on the D scale under the index of the tangent scale. If the diameter is known the gauge size may be found as before described. This places every thing before the operator and a little practice will enable one to use it very readily.

In the event that it is desired to know the ohms per lb. instead of per 1000 ft. then by dividing the resistance per 1000 ft. by pounds per 1000 ft. we have the ohms per pound as the result. To find the pounds per 1000 ft. proceed as follows: with the slide in the front position, place either index of the C scale on the diameter on the D scale and read the result on the A scale over 174 on the C scale. The position of the decimal point can be determined by remembering that 1000 ft. of No. 5 weighs 100 lbs. exactly, No. 15 weighs 10 lbs. (9.855), No. 25, 1 lb. (.9699), and No. 35 1/10 pound (.095.45).

For example, suppose it is desired to find the resistance of one pound of No. 14 wire, by reversing the slide and placing 4 over either index, under the index of the T scale on D we read 25.15 and since the characteristic is I we point off one decimal point and our result is 2.515 ohms per 1000 ft. (The correct resistance is 2.521). We must now find the pounds per 1000 ft.: first find the diameter of No. 14 by placing N over 4½ inches and the result is 64 mils, now with the slide in the front position, place the right index of C over 64 on D, place the runner on 174 on C and read 124 on A. Since we know that 15 weighs 10 lbs. per 1000 ft.. and No. 5 100 lbs. per 1000 ft., it is evident that No. 14 will weigh 12.4 lbs. Dividing the ohms per 1000 ft. by the pounds per 1000 ft. or 2.521/12.4 the result is .2028 ohms per pound, which is exact.

To find the feet per pound of a given size of wire place the mantissa of the size number on the L scale on the right index on the back of the rule and read the result on the D scale under 32. As in the case of finding the pounds per 1000 ft. it is necessary to remember that if a 1000 ft. of No. 5 weighs 100 lbs. then one pound of No. 5 would be 1/100 of a 1000 ft. or 10 feet long (9.98) and a pound of No. 15 would be 100 ft. long (101.4), a pound of No. 25 1000 ft. long (1031.) and a pound of No. 35 10,000 ft. long (10480).

For example, let us find the number of feet to a pound of No. 11 wire by placing one on the L scale to coincide with the right index on the back of the scale under 32 on the C scale we have 403 on the D scale; 1 is between 5 and 15 we know that the length must be between 10 and 100 ft., so placing our decimal point accordingly, we have 40.3 ft. (The correct length is 40.12 ft.)

The number of feet per ohm of a given B. & S.

[1]Buxbaum & Cooley, Seattle, Wash.

size of wire can be read on the D scale, with the logarithmic scale in front, both ends coinciding under the mantissa of the size number. Subtract the characteristic of the number from 4 and point off decimal places equal to the result. To find the number of feet per ohm of No. 17 wire with the L scale in front, ends coinciding, we read 1990 under 7, subtracting the characteristic from 4 leaving 3 and pointing off 3 places, we have 199 ft. of No. 17 to the ohm (A. I. E. E. table gives 197.8 at 20 degrees C.)

The area of a wire is of course the square of the diameter. With the gauge size given the diameter can be obtained as before stated and the area readily obtained. A convenient way for obtaining approximate results is as follows: Reverse the slide with the logarithmitic scale in front, place the left index over 10380, the area of No. 10, then under the mantissa of the gauge size on the L scale read the area in circular mils on the D scale. Subtract the characteristic from 5 and point off decimal places equal to the result. The reading in this case for No. 5 wire is 32800. The correct area is 331.02.

Solution of Wiring Problem With Log Log Rule[1].

There has been recently placed upon the market by Keuffel & Esser Company of New York City a Log Log Duplex Slide Rule that simplifies the solution of any problems involving powers and roots of numbers. As all relations between gauge numbers and their diameter, area, resistance and weight may be thus expressed this rule is particularly useful for solving these problems. Consequently a brief description of the rule and remarks upon its application to the solution of wire problems may be of interest.

The Log Log rule contains all the markings of the Mannheim rule in even more convenient form, and in addition has a so-called "Log Log" scale laid off proportionally to the logarithms of the logarithms of a series of natural numbers. This position of the rule consists of three scales designated LL_1, LL_2 and LL_3, which are graduated respectively from $e^{\frac{1}{100}}$ to $e^{\frac{1}{10}}$; $e^{\frac{1}{10}}$ to e and from e to e^{10}, e being 2.71828, the base of the hyperbolic or natural logarithms. Consequently any problem containing logarithms. either hyperbolic or Briggean can be readily solved by its means.

Also any desired operation of involution or evolution may be performed within a range extending from 1.01 to 22,000 with any exponent. Extracting any root or raising to any power, integral or fractional, is solved directly by locating the root on the Log Log scale, the exponent on the log scale and reading the power on the Log Log scale.

As the Log Log rule is arranged with a scale of equal parts, or L scale, beneath the D scale, the method proposed by Mr. Sakai for determining the resistance form is greatly facilitated, as the reading may be made without the inconvenience of turning over the rule. This method involves a proportional approximation, which is reduced by employing the Log Log scale in connection with the formula, $r = \frac{1.26^n}{10}$, which is derived from the inverse ratio of resistance and area. Consequently, the ohms per 1000 feet of any wire is ascertained by setting index of C opposite 1.26 on the LL scale and opposite the wire number on the C scale reading the desired resistance on the LL scale. This further obviates the necessity of any consideration of characteristic and mantissa. These resistances are correct for 10° C. 98 per cent Mathiessen's standard.

These may be further corrected for temperature according to the method described by Dr. Harold Pender in the Electrical World of April 13, 1907, wherein he marks C scale of the slide as follows:

Slide Rule Number.	Marking of New Scale.
238	0
248	10
258	20
268	30
278	40
288	50
298	60
308	70
318	80
328	90
338	100
etc.	etc.

Suppose a copper wire to have a resistance of 300 ohms at 13 degrees C., what will be its resistance at 100 degrees C.? Set 13 on the new slide scale opposite 300 on the lower scale and read on the lower scale the desired resistance 404 opposite 100 on the new scale.

The method of Mr. Falch for finding the diameter from the gauge size and vice versa, is readily applicable in using the L scale instead of the scale of inches. The writer believes, however, that by the use of the Log Log rule, the method is simplified. Opposite 1.1229 $\left(\sqrt[39]{92}\right)$ on the LL scale set the index of C and read the result on the LL scale opposite the gauge number on the C scale. Set this result on the C scale opposite 3249 on the D scale, and read the diameter in mils, opposite the index of the C scale. Similarly to find the area in circular mils set the index of C at 1.2605 on the LL scale; read the result on the LL scale opposite the gauge number on the C scale and set it on the C scale opposite 105,000 on the D scale, reading the area opposite the index of C scale. In like manner, the ohms per thousand feet $= \frac{1.2605^n}{10}$ and lbs. per thousand feet $= \frac{320}{1.2605^n}$

Feet per pound may be found in the same manner as directed by the author, using the L scale, without the necessity of turning the rule. Likewise with feet per ohm.

In electrical engineering many formulas are used that involve fractional powers, hyperbolic logarithms, etc., all of which may readily be handled with the Log Log Slide Rule.

The capacity in electro-static units of a long transmission line is given in the following formula:

$$C = \frac{l}{2 \operatorname{Log}_e \frac{l_1}{r}}$$

[1]Editor's note.

Set 2 on CI to quotient of $\frac{l_1}{r}$ on LL Scale; over l on D read answer on C.

Here the hyperbolic log of $\frac{l_1}{r}$ is used directly as a factor, and the formula is solved at one setting of slide after obtaining the value of $\frac{l_1}{r}$.

If length l is required, the formula becomes $= l$ 2 C $\text{Log}_e \frac{l_1}{r}$ which would be solved as follows:

To quotient of $\frac{l_1}{r}$ on LL Scale, set "C" on CI; under 2 on C Scale read answer on D.

Hysteresis loss is given by the formula $Wh = nB^{1.6}$ which may be solved as follows:

Set index of slide to B on LL Scale; over 1.6 on C read value of $B^{1.6}$ on LL Scale, which multiplied by n gives the value required.

The resistance of dielectrics is given by formula.

$$R = \frac{I\,t}{C\,(\text{Log}_e E_1 - \text{Log}_e E_2)}$$

Under E_1 and E_2 on LL scale read Log_e on D. Take the difference and use as a factor on the regular scales in the usual way.

The variations in resistance of dielectrics with temperature is expressed in an exponential equation.

$$R_o = R_t\, a^t$$

Where R_o = resistance at standard temperature.
R_t = resistance at temperature differing t degrees from standard.
t = temperature.
a = constant depending on material.

For pure rubber, t in degrees C ..... $a = 0.95$
For gutta percha, t in degrees C ..... $a = 0.88$

R_o can be found in any of the handbooks of electrical engineering.

In calculating the tension and sag in wire spans all calculation with catenary curves involve the fundamental expression:

$$\text{Deflection} = \frac{1}{2a}\left(e^{\frac{ax}{2}} - e^{-\frac{ax}{2}}\right)^2$$

both abscissas and deflections being measured from the lowest point, or vortex, and a being the quotient of weight per foot divided by horizontal pull. Such expressions are easily handled by the rule, $e^{\frac{ax}{2}}$ being read on the log-log scale opposite values of $\frac{ax}{2}$ on the log scale, with slide in zero position. Then $e^{-\frac{ax}{2}}$ is the reciprocal of the quantity so found, and may be read off by use of the CI scale. The rest of the computation is self-evident.

A telephone newspaper, giving similar service as in Budapest, is to be established in New York City by a company to be known as the Telephone Company of America. Subscribers obtain over the telephone a summary of the day's news and at night are connected with some opera or other theatrical attraction.

SOME CALIFORNIA NOTES ON HIGH TENSION TRANSMISSION LINES[1].

BY S. L. FOSTER.[2]

As what is generally understood by "high-tension transmission" has existed for but 18 years, or since the Frankfort to Lauffen demonstration startled every one in 1891, though this was really only a lighting proposition, and as street railway high-tension power transmission has existed about half that time, few railway electrical men have become familiar with the art much further than as existing under local conditions.

An article on the subject thus must savor much of the locality from which the author writes, both from the above reason and because the local conditions really govern the details of construction.

In California are found some of the longest transmissions, the highest voltages, and at the same time some of the best and some of the worst electrical conditions. Much that is of vital interest here is only of historical interest, or perhaps incredible to engineers east of the Rocky Mountains. Much that interests those of the East is valueless here.

We have no sleet or snow loads, no sleet nor snow driving or accumulations, no tornadoes, and practically no tree or lightning interferences such as are met with in the East.

For high-tension station outlets we simply build ordinary terra cotta sewer pipes, bell ends inside, into the walls, set a circular perforated disk of plate glass in each bell end, and lead the wire through the center of the 2-in. or 3-in. hole in the plate, having thus ample clearance and ample insulation. The hole aids station ventilation. There is no snow to fear, and the upward tip of pipe toward the inside of the station obviates danger from rain. In later 60,000-volt work a 24-in. square of glass with a central 3-in. hole for the conductor is used, and the terra-cotta pipe feature omitted, as birds sometimes build nests in them. Lightning arresters are usually conspicuous by their absence, as are also the effects of lightning.

As compensation for these advantages, however, we have in some parts of the country eagles, wild swans, pelicans or blue herons with over 6 ft. spread of wings, that occasionally short-circuit even 72-in. spaced wires. We also have from four to six months of rainless weather during the summer when the dust becomes prevalent. In addition, along the coast and bays we have spells of heavy fogs at night.

The combination of dust, fog and night wind applies a conducting smear over the insulators, the pins, the cross-arms and the poles of our high-tension lines, that results in most unexpected and extraordinary phenomena to disturb the electrician's equanimity.

One effect appears in the fact that in a few, though important, localities a voltage test factor of safety of six in the insulator is inadequate to secure continuous operation.

Another is the fact that the brush discharge from insulator to wood pin generates nitric acid from the nitrogen of the air and the hydrogen and oxygen of

[1]Extract from Report of Committee on Power Distribution, American Street and Interurban Railway Engineering Association's Denver Convention, October, 1909.

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the fog or air. This nitric acid attacks and "digests" the threads of the wood pin top until it becomes a powder, and the thread ceases to serve as a support.

As the surface of the pin, where unprotected by the insulator, is covered with the moist paste of salt, dust and fog drops, it is a better conductor than the protected part of the pin, and is not attacked at first. On the drier and more highly resisting part of the wood pin, up under the insulator, the heat generated by the leakage current appears first, but as the moisture is dried out of the other surfaces the evidences of heat appear, and pins, cross-arms and pole tops suffer.

Brown striation marks on pin, arms and pole, charred "worm holes" in pins, wood pins burned off altogether, leaving insulators adrift in the air, cross-arms charred or entirely burned off around the iron pin or at the gain in the pole, are some of the strange symptoms of the disease.

The "static" or "brush discharge" or "Corona," as it is variously called, cracks, and snaps between insulator and pin by day and scintillates by night.

All these interesting manifestations occur on a 13,000-volt, 25-cycle, three-phase line, 24-in. spacing, equipped with porcelain two-part insulators tested by the author to 50,000 volts, and advertised by the maker as "test voltage 70,000."

Of course, these eccentricities do not occur every day nor continue all the day when they do occur. In fact, they cause very few interferences with our city 13,000-volt service, but to one accustomed to the prosaic behavior of the insulator on the 500-volt d. c. work they are mighty interesting doings and keep us guessing sometimes.

The cause of the burn-off's at the pole is a natural query, and various theories have been advanced.

At first, the two ¾-in. galvanized iron machine bolts holding the cross-arm to the pole passed through the pole, as was the classical practice derived from the Eastern lag-bolt custom. After much trouble from fires in cross-arm gains during foggy weather, it was felt that it would be an improvement to do away with these through bolts and substitute a U-bolt that would go around the pole. This is now standard practice, and the author has heard of no cases of fires in cross-arm gains where the U-bolt construction has been installed. (Since writing this have heard of two cases.)

In the early 60,000-volt, 150-mile transmission construction the single-three-wire circuit was constructed at the points of an equilateral triangle apex up, using a single cross-arm and setting one wooden pin into the top of the pole.

In the fog district even a spacing of 42 in. between conductors and insulators, tested to 120,000 volts, failed to be infallible on the 60,000-volt line, and fires started around the "kingpin," and even further down on the pole.

The theory was advanced to explain these phenomena that there were certain paths of varying conductivity in or between the fibers of the wood pole, and that in this star-connected line with grounded neutral the potential tended to force current along these conducting paths, and as the moisture was evaporated the persisting current caused heating and the fire.

To break up this action by breaking the uninterrupted course of these paths the pin was removed from the center of the pole and mounted on a short one-pin cross-arm bolted around the top of the pole.

The wood pins had been "digested" seriously in the "fog belt" by the "brush discharge," and were replaced by hollow galvanized iron pins provided with lead threaded tops. These wood pins referred to were made of eucalyptus or Australian blue gum, which is stronger than the locust or oak usually furnished in pins, and is equal to hickory. The wood is specially seasoned and treated for this purpose. Sawed into sticks 3 in. square, the wood is boiled in water for 24 hours, thereby being deprived of its sap. These pieces of wood are then arranged for efficient drying, and so exposed for three months. After being turned to shape, the finished pins are boiled in linseed oil at a temperature of 100 degrees C. for several hours, the oil penetrating about 1-16 ot an inch and serving as a protection against moisture. When new in the laboratory these pins readily withstand a 60,000-volt test from end to end. Thus there seems to be no ground for a claim that thorough work was not done on the wood pins.

The form of construction just described represents about the last steps in constructing combustible or perishable high-tension overhead work. The next step is to the steel tower, the steel cross-arm and the suspended insulator.

It is not necessary to go into details concerning the ingenuity that was expended in efforts to make wooden pins answer in high-tension work here. It all failed, as is evidenced by the array of iron pins now on the market, and the practice on the latest transmission projects. The day of the wood pin is practically over on the Pacific Coast.

The 13,000-volt line referred to was built in 1902, after observing the difficulties of an 11,000-volt, 60-cycle, three-phase line, that with 24-in. spacing and wood pins, could not succeed during the foggy weather with triple-petticoat glass insulators, which have been used successfully on a 44,000-volt line in Utah. This new San Francisco line has about 4000 insulators, 20 miles total length of pole line, 82 miles total length of conductor—0000, 000, 00 copper, some 0000 solid, some stranded (no advantage found so far in use of stranded wire), equilateral triangle arrangement apex up, no transposition, no cross-arm braces, no line lightning arresters.

Poles.—50, 60 and 70-ft. square, sawed, planed, tapered redwood, cut from the hearts of young trees—16 in. by 16 in. at butt, 10 in. by 10 in. at top—set 6 ft. deep in concrete—stepped with galvanized-iron step irons. In the suburbs some 40's and 35's were used.

Cross-Arms.—4 in. by 6 in. clear Oregon pine, similar to the Norway pine of the East, bolted to gained poles originally by 2¾-in. through bolts, but on latest work and in case of burned off cross-arms by ¾-in. U-shaped galvanized bolts passing around the pole.

In this climate, all ironwork on poles, such as lag screws, bolts, braces, steps, etc., is galvanized by the hot-dip process to prolong life and to prevent streaking with rust.

When a cross-arm burns off, if there are two triangular circuits on the pole top, a new arm is substituted for the burned one, as it always burns off

at the gains, and instead of two through ¾-in. machine bolts a ¾-in. U-bolt is used on the new arm. If there be but one circuit on the two cross-arms, arranged in a triangle on one side of the pole, the three wires are simply transferred temporarily to the other side of the pole to the sound part of the arm, as the arm in this single circuit work always burns off at the pinhole nearer the pole and leaves the part of the arm in the gain sound. (Our latest so far very successful practice developed this summer, since writing this, has been to install an insulator of higher efficiency on the pin next the pole in the lower arm carrying the two insulators of the triangle.) In each case, lead pin tops are substituted for the digested wood ones, and new insulators substituted for the old ones.

Pins.—On straight line work composite pins were used, consisting of ⅝-in. galvanized wrought iron carriage bolt, threaded wood top and truncated conical porcelain base.

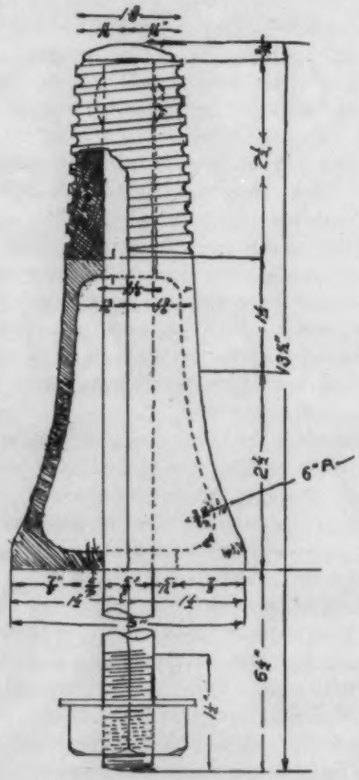
The nitric acid formed by the brush discharge has "digested" many of these threaded oak tops, and as opportunity offers or necessity requires, they are replaced by threaded lead tops. When from "digestion" or burning of wood top of pin it seems necessary to take some action, a threaded lead top is substituted for the threaded wood top without washing, wiping or changing the insulator. No recurrence of similar symptoms on identical poles have been recorded, either where cross-arms have been burned or wood pin tops digested.

Another company profiting by our experience did not attempt to use the wood tops, but retained the rest of the parts of this composite pin, cementing the bolt into the insulator with litharge and glycerine.

The brush discharge occurs during very heavy fogs, between lower insulator petticoat and iron pin, but so far (four years) with no serious results.

The theoretical explanation of this performance of burning wood top on a composite pin was given in 1893 by Mr. Philip Torchio, in the "Proceedings of the Institute of Electrical Engineers," page 293. It is that the iron pin and the porcelain insulator, when held apart at a certain difference of potential, would act as a condenser, with the air as the dielectric between them. When the wood pin top is inserted it makes the conditions of those of several condensers in series, and produces a lack of uniformity in the distribution of the e.m.f. between line wire and iron pin, raises the voltage between porcelain and pin, and, assuming that the potential before the wood top replaced the air as dielectric was the critical point, causes the brush discharge and the charring of the wood. The wood non-conducting tip would thus seem to be a distinct disadvantage, and the conditions would be improved by replacing it by a tip of conducting material, lead, for example.

In place of the perforated pyramidal porcelain base, experience would seem to advise a through threaded bolt provided with nut and washer both below and above the arm to furnish ample area of contact for the dissipation of this unwelcome "static." (Since writing this a pin according to the accompanying illustration, has been thought best—galvanized iron bolt, lead top, galvanized cast iron base.) Cross-arms sometimes burn off around through insulator bolt, and this has been believed to be due to the looseness of the bolt, caused by the charring away of the substance of the wood top and the reduction of the pin's long dimension by the iron bolt being forced through the arm by the weight of conductor and insulator crushing down the charred wood top and leaving nut and washer of bolt hanging free of contact with lower surface of arm. On a foggy night, besides the purple ring of fire along the edge of the inner petticoat of the porcelain insulator, a pretty "corona," or halo effect, or diminutive "aurora" effect, is seen around the edge of this washer at the bottom of the pin. Accompanied by a distinct hum and an unmistakable odor of ozone, a circle of short, beautiful electric emanations or uninterrupted series of discharges can be seen going apparently from the edge of the iron washer to the wood cross-arm.



Metalic Pin for High Tension Insulators

For corner work a 1⅜-in. galvanized iron pin is used cemented into the insulator with a mixture of litharge and gylcerine.

These ingredients are mixed on a glass plate with a putty knife to a stiff paste. The pinhole of the upturned insulator is filled to the proper height and the pin pressed into place, being held central in the hole until the compound sets, by wooden wedges. Pins thus cemented are usually allowed to stand for 24 hours before being used, though this setting depends on the weather. In rainy weather 24 hours is not long enough. In dry weather haste must be used lest the cement set before the pin can be inserted.

These pins are only roughened at the ends going into the insulator so as to hold the cement. At the other end they are threaded so as to permit of a nut and washer going both below and above the cross-arm.

Insulators.—The insulators generally used are a two-petticoat brown porcelain, umbrella-top insulator. When building this 13,000-volt line it was specified that the insulators should pass a 50,000-volt brine test.

All that were accepted (about 80 per cent of the shipment) passed this test, which consisted of inverting the insulator in a metal pan of brine connected to one pole and putting a wire in the brine-filled inner petticoat connected to the other pole of the testing set. Today the manufacturers advertise these insulators as "Test Voltage 70,000."

With two of these in series, each having 13 in. of creepage distance between conductor and pin, it was felt that the construction was safe from leakage, but we were disappointed.

The 20 per cent that were punctured in the testing made the makers feel so badly that they now insist on the insulators being tested at the factory before shipment.

Insulator Troubles.—The "static" or "brush discharge," or "Corona" that is active in certain localities during six months, or during our summer months when sea fogs are prevalent, "digests" some of the wood tops of our composite pins as stated. It has led in a few cases to burned-off pole tops, where the cross-arm was fastened to the pole by bolts passing through both. A small red hot coal appears at the cross-arm gain, and in the steady night wind this is soon fanned to a busy flame. The first case reported was attacked with a piece of burlap, no use; then sand was tried, equally unsuccessful; then the current was cut off, the fire extinguished with water and the night's run finished, the arm and insulator being changed the next day. U-bolts around the pole are now used instead of through bolts.

One day a policeman reported the top of a "high pole on fire." The sub-station was called—"no trouble on the line." A representative hastened to the location and found a fire engine just leaving, with the fire out. These firemen had actually played water from their hose on that pole top fire with six 13,000 volt wires on the cross-arms and had received no shock, their state of mind being made clear by the jocular remark of the captain to the wondering electrician, "I like a little job like that before breakfast." This happened at about 8 a. m., and after the unusual bath the lines continued to work normally till 1 a. m. the next morning, when the cross-arm and insulators were changed. There was no disturbance whatever from the fire or hosing felt at the power house or sub-sations.

Some engineers in testing insulators use the spray test. In the "fog belt" out here we would like to have a spray on all our insulators all the time. In the winter, when we have long spells of continued rain, we have no insulator trouble at all. During the summer the fog and dust form a conducting paste that at some points leads to all the peculiar exhibitions previously detailed. As soon as the first rain of winter has washed off this paste the troubles vanish for six months. So far, no evidence has been reported of the lead-pin tops or cementing being affected by this "static."

When the fog is persistent and the action gets serious, we stop it readily enough by washing the insulators with ordinary water inside and out, but without removing them. It is expensive and slow work washing insulators in the cold wind and fog at night on the tops of 50-ft. poles, but in certain exposed locations and during particularly severe stresses of foggy weather it is the only remedy. Washing is more effective than wiping. Sometimes this paste forms a plating or enamel that cannot be removed entirely by even gasoline. It has never occurred the second time on the same pole, and usually starts on a pin that is on the lee side of the pole, away from the direct blast of the fog-laden sea breeze. (Since writing this, it has called for more frequent washing or a better insulator.)

In the beginning there were four types of porcelain insulators in use, all having passed the 50,000-volt test, but since the number has been reduced to one, there has been one burned-off pole in six years that resulted in an interruption to the service out of 1000 poles, and this one occurred on a pole standing 15 ft. from a chemical factory. There was more than one burn-off, but the others occurred, fortunately, either on a duplicate line or near the regular shutting down time.

When the fog is absent it is marvelous how little porcelain is required to insulate one wire from its neighbor. During our recent strikes, or due to malicious boys, two adjacent insulators have often been seen with the outer petticoat in both cases entirely gone, and yet there was no evidence of trouble, and they were left undisturbed till shutting down time.

The best defense against this fog and dust action is a generous insulation factor of safety in the insulator (say, make a test voltage six times working voltage), which should always be of porcelain, as being less hygroscopic than glass and tougher. If this fails, the last resort is the cloth and the water pail at night.

Of course falling tree limbs, the busy small boy with his piece of wire, or the malevolent striker with his chain have burned off our line a few times, but so far without injury to persons or property.

Much of this would be prevented by having had the three wires of the line arranged with the apex of the triangle down.

One power company in San Francisco goes farther, and besides arranging the three wires on an inverted equilateral triangle plan, extends light galvanized iron channel irons along the line of the ends of the cross-arms and 3 ft. beyond. A guard wire is stretched along the tops of these upward projecting points.

Some of the lines arranged on the apex down plan offer an attractive roost for eagles and hawks. When the bird stretches his wings for his final hop into space he short-circuits the two wires, and incidentally kills himself.

Precautions During Work.—When making repairs, even if assured by the station men that the current has been cut off, the linemen always hang an iron chain over the three wires to prevent the current coming on again without warning. No lineman has ever been injured on our 13,000-volt lines.

Switching.—All our arc-rupturing switching is done in the power house or sub-station by means of oil switches. There are installed, for convenience in

cutting up the lines for repairs, two double sets of double-break, triple-pole, horizontal swing-knife switches, but it is never intended to open these when the main current is flowing.

Corners or Turns.—At corners or turns in the pole line, care was used to secure simple yet safe work. The angle made by the line wires at each turn was bisected exactly by the cross-arms. As the poles were of square section and sawed truly from base to top, a triangular flat template was furnished the line men to set against the curb-stone. By bringing the side of the pole against the proper side of the template the cross-arm was automatically located along the line bisecting the angle made by the wires.

In the first construction, in order to attain a factor of safety of 13 with the use of eucalyptus or Australian gum tree wood pins, which were the standard here in 1902, three insulators were used at each turn, and as there were but 12 in. from center to center of outside pins, it was specified that the special insulators to be used for corners should not exceed 6 in. in maximum outside diameter.

The San Francisco fog paste proved to be too much for these insulators, and two insulators are now used of our standard type, cemented over our standard wrought-iron 1⅜-in. galvanized corner pin, giving a factor of safety of about 60 in the pin when using 000 copper conductor.

This method of making the turn has a neat appearance and is economical in the use of cross-arms, insulators and labor.

Of course, if the same spacing between pins is maintained on these corner cross-arms as on the straight line arms, the conductors are brought nearer together at the corner poles by the difference between the standard spacing and the product of this spacing and the sine of half this included angle bisected. By spacing the pins on the corner arms a distance equal to the quotient obtained by dividing the standard spacing by the sine of half the bisected angle the conductors can be kept equally distant at all points. This refinement is not often necessary in our work, as the poles carrying the high-tension wires were also used to support the trolley span wires, and have the usual spacing of from 100 to 120 ft. In the case of 24-in. pin spacing and 135 angle turn the spacing at the cross-arms between the wires is 22.17 in. By spacing the pins 26 in. on the corner arms the conductors will be kept 24 in. apart.

In the original use of three insulators per wire on one set of cross-arms at what would be 135° turn on a single insulator the symmetrical arrangement of these three insulators is secured when there are angles of 165° made in the conductor at each insulator.

The digging of holes was done by shovels, bars or dynamite, according to whether the material to be excavated was sand, clay or rock.

Some of these 50 and 60-ft. poles were piked in, some were hoisted in by a portable "gin pole" with hinged base mounted on a low truck along with a double-geared winch, using as gin poles the 30-ft. 5-in., 6-in. or 7-in. standard pipe iron side poles, which were to be replaced by the taller poles.

The other methods of completing the line contained nothing different from standard practice.

The last six years' experience has taught us how to construct and how to maintain our high-tension lines so as to escape the interesting effects of fog and dust.

The results summed up are as follows:

1. There should be a larger factor of safety in test voltage of insulators to be used in the foggy localities than elsewhere, say six.

2. To keep the insulators up to a safe margin these insulators should be wiped or washed once a year in the most aggravatingly foggy locations.

3. The through bolts for attaching the cross-arms should be replaced by the U-bolt around the pole.

4. The all-wood pin or the wood tipped iron pin should be replaced by the all-iron pin with the threaded lead top.

5. No pin should be located in a hole bored in the top of the pole, but should be installed on a short arm bolted to the pole by a U-bolt.

6. All iron parts should be galvanized.

7. An insulator with few "still air spaces" is preferable to one with many such spaces, no matter what the comparative "test voltage" may be.

8. If wood pins are used, very many will surely burn off during the foggy conditions. If iron pins are used, a few cross-arms may burn off. In any case the main dependence must be on the insulator.

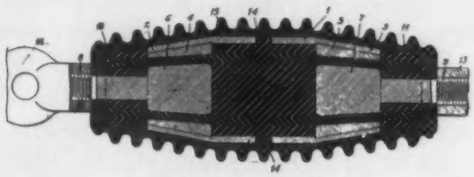
The latest practice used by a local 60,000-volt company to combat this static burning on wood pole, wood crossarm work is to "ground" the iron pins of all these insulators on the theory that it is a discharge to earth and not a discharge between wires that causes the phenomenon.

Standardization of electrical mine equipment forms the subject of a preliminary report from a committee of the American Mining Congress. A code of rules is being revised with the intention that they may be enacted by the several State legislatures. In addition to this formal code the committee proposes to prepare a set of recommendations setting forth what it considers the best practice, and which, if followed, would tend to reduce the danger of personal injuries due to the use of electricity in mines, reduce the liability of explosions in gaseous mines, improve the efficiency and reliability of the service and tend to make the use of electricity more satisfactory both to the operators and the mine workers. These recommendations will go farther than is possible in a set of mandatory rules.

The electric automobile is to be given considerable attention by the National Electric Light Association this year. President Frueaff does not consider that central station men have been as alive to the possibilities along this line as they should be, that automobiles present a great opportunity for the improvement of the load factor, and as city streets are getting better the possibilities throughout the country are greatly improving. He believes that the larger cities will eventually legislate against the gasoline machine on the grounds that in crowded thoroughfares the stench from them is often a serious nuisance and particularly when it is known that the electric automobile will do the same work at a less cost.

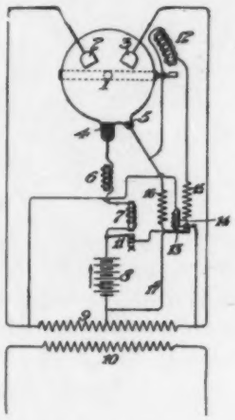
PATENTS

938,092. Strain-Insulator. Theodore Varney, Pittsburg, Pa., assignor to Westinghouse Electric & Manufacturing Company. A strain insulator comprising a metal tube having taper ends, metal bushings seated in the ends and provided with taper holes, taper sleeves of insulating material seated



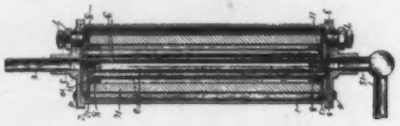
in the holes, taper plugs seated in the taper sleeves and having outwardly projecting stems, and a molded casing of insulating material which seals the tube and extends from one stem to the other.

937,971. Starting Device for Vapor-Converters. Percy H. Thomas, Montclair, N. J., assignor to Cooper Hewitt Electric Company, New York. The method of starting a vapor electric rectifier characterized by and supplying a receiving



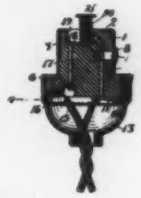
circuit containing a source of counter electromotive force which consists in initiating a flow of current in the rectifier in a direction opposite to the normal direction and utilizing the cathode activity thus produced to overcome the starting resistance of the normal cathode.

938,127. Electric Heater. Harry W. Denhard, San Francisco, Cal., assignor to George B. Katzenstein, Jr., San Francisco, Cal. In an electrical heater, a fluid chamber, a positive electrode therein, one end being supported in electrical connection and the opposite end having an insulated support, a



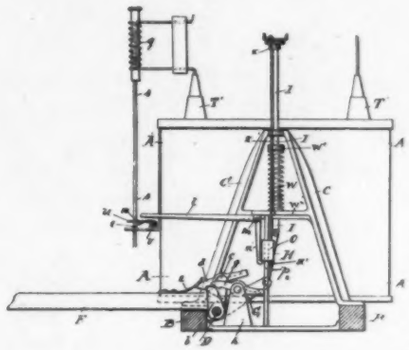
negative electrode having an electrical connection and support at one end and an insulated support for the opposite end, an inlet or outlet for a suitable liquid, the said liquid furnishing the necessary resistance, substantially as described.

938,238. Electric Attachment-Plug. Seykichi W. Ito, San Francisco, Cal. An attachment plug for lamp sockets comprising an insulating plug having a reduced portion, a contact shell around said reduced portion having a tongue cut therefrom, a rock shaft, parallel with the axis of the plug and of the shell, and having a cam arranged to project said tongue to cause the same to bind against the socket, an arm on said rock shaft for turning the same, contact clips with which said arm is adapted to engage when the cam has been



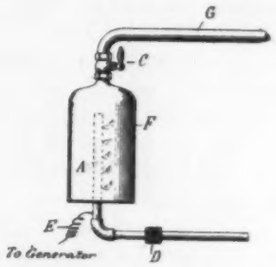
moved to so project said tongue, a spring arranged centrally of said plug, a contact head carried thereby and two conducting wires, one of which is electrically connected to said spring and the other is connected to said contact clips, substantially as described.

938,324. Automatic Circuit-Breaker. Joseph N. Kelman, Los Angeles, Cal. In a high potential switch and circuit breaker wherein the parts for opening the circuit are operated from and by the moving of a stiff member, a vertical rod suspended from said stiff member, a weight having a hole



through it encircling said vertical rod thereby connecting said weight to said stiff member, said vertical rod having a stop at its lower end by which said weight is lifted into potential position by the moving of said stiff member after said weight has fallen upon the pawls and released the opening mechanism of the circuit breaker.

937,759. Process of and Apparatus for the Production of Ions. Lucien I. Blake, Denver, Colo. The process of producing and delivering into the air gaseous ions, herein described,



which consists in electrically charging by an external source of electro-motive force, the generating or gaseous dissociating flame or source of heat in which they are developed.

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Education Without the College

Too much emphasis is usually placed upon the importance of the college as a factor in the education of the engineer. All of us are learning, all the time, and at all places. When we cease learning, we stop living. The school is one place to learn, but it is not the only one. The school and the college lead along the pathway of knowledge, but should not degenerate into the common roadway of routine. Youth receives the clearest and most lasting impressions, and should therefore be early acquainted with something beyond the school.

A student, like an athlete, can be overtrained, and "grow stale." This can be prevented by shortening the time of his strenuous effort, by taking out the non-essentials, and by giving some flexibility to the requirements. In a rigidly prescribed course, each man is cut to the same template, leaving little opportunity for originality and imagination. The wall paper admired by the connoisseur is not the product of the printing press, but the design of a freehand artist.

The determination of what is essential should be governed largely by the individual requirements. In selecting any course, the criterion should be the purpose to which the student's energies are to be applied. These essentials can be learned as well without college as within. It requires greater persistence and will power to learn them without the supporting guidance of a personal teacher, but the impressions are correspondingly more lasting. There are few engineers who would not be glad to suggest such a course of study as a supplement to practical work. When the limited horizon of the student has been widened to that of the practical man, he is then able to determine what work is more congenial and remunerative, and to perfect himself along those lines. With the proper ground work, he can use the knowledge as tools to dig out his specialty.

One of the most important functions of the scientist is to explain things that have been discovered by the practical man. For instance, American mineralogists noticed, while sectioning Canyon Diablo meteorites, certain grains of adamantine hardness. Gem experts reported them diamonds. It remained for Moissan to saturate molten iron with carbon, to cool slowly with great pressure, and to show the world minute glittering crystals readily recognizable as diamonds. Columbus, the intrepid mariner, with his pigmy fleet, was baffled by the variation of the magnetic needle, his only guide, aside from his hope, his imagination and the stars. Yet it remained for the scientist to explain the laws of this declination. The many puzzling phenomena attending the transmission of alternating current are readily explained by the genius of Steinmetz.

CURRENT COMMENT

The Pacific Coast Electrical Exposition will be held at the Coliseum in San Francisco from January 29 to February 5, 1910.

Reinforced-concrete ties have not proved entirely satisfactory for heavy and high-speed traffic. Properly fastened under conditions detrimental to wood or metal ties they may be safely used for low speeds.

Examination for Junior Electrical Engineer in the geological survey is announced by the United States Civil Service Commission on November 23-24, 1909, at a salary ranging from $960 to $1200 per annum.

Hydro-Electric Power in Switzerland capable of development totals one million horsepower, of which one-fourth is now utilized. The local government usually retains ownership of all public rivers and lakes.

The field of the electric steel furnace, according to the Electro-chemical and Metallurgical Industry, is an adjunct to the Bessemer converter if it can make steel of open hearth or better quality at the same or less cost.

The ease of starting an electric vehicle was exhibited this week by a three-year-old Pasadena boy who frightened his parents by riding off in their machine unattended. After a wild ride of two blocks the boy was rescued uninjured.

The annual meeting of the Sons of Jove was held on October 14 and 15 at Cleveland, Ohio, with an attendance of 175. In addition to several entertainments a class of nearly 100 was initiated, giving a total membership of over 2500. Oscar C. Turner of Warren, Ohio, was elected Eighth Jupiter.

An insulator must be able to withstand mechanical and electrical stresses due to voltage, have small conductivity and be resistant to chemical action caused by the electric current. It should also not be volatile or hygroscopic and should be fire-proof. All of these properties do not exist in any single substance, and consequently it is necessary to use mixtures.

A substitute for platinum has been found in an alloy recently patented by E. B. Craft and J. W. Harris of the Western Electric Company. This alloy consists of 67½ to 70 per cent gold, 25 per cent silver and 5 to 7½ per cent of nickel. As used for electrical contacts this is claimed to have all the characteristics of platinum in addition to being harder and cheaper.

During a gas producer test, according to a recent bulletin of the U. S. Geological Survey, the fuel bed should be maintained in uniform condition, with regard to both the character of the fire and the thickness of bed; but that failing in this, special care should be exercised to see that the fuel bed is in the same condition and of the same thickness at the close of a complete test, or at the end of a test period, as at the beginning; that a test should never be started when the producer has been standing idle for some time with "banked fires," as the fuel bed will not be in the average condition under which it will be required to work during the test; that, if, as the appointed hour for closing the test approaches, the fuel bed is not in proper condition, the time of closing the test should be postponed until the bed naturally assumes the proper thickness and character. No forcing of conditions should be allowed simply to bring the test to an end at a previously determined hour.

One-sided loading of Tacoma street cars has resulted since the street car company increased the suburban fares on the Regent's Park line. One rail of this line lies in the city, where not more than 5 cents fare can be charged. The other rail lies in the county. The passengers insist upon riding on the city side for fear that they may have to pay more if they ride on the other side, and the cars list like half-loaded schooners.

Wireless interference with lighting circuits in Oakland, California, has become so troublesome that the city electrician has started an investigation, with the view of preparing an ordinance to regulate the nuisance. The officials of the Oakland Gas Light and Heat Company declare that the experiments of amateurs have resulted in much trouble and the filing of complaints by patrons of the company on account of the blowing out of fuses and puncturing of fixtures.

Electrical causes of mine explosions are being examined by the Technological Branch of the United States Geological Survey to determine the condition under which explosions could be caused in gaseous mines by the breaking of incandescent electric lamps, blowing of "safety" fuses, sparking at the brushes of motors or flashes on electric signaling wires. The effect of acid mine water on various kinds of insulated wire and cables is also being investigated, with the hope of finding an insulation that will be permanently satisfactory under the severest mine conditions.

Examination for junior engineer in the geological survey is announced by the United States Civil Service Commission on November 23-24, at salaries ranging from $840 to $1200 per annum. Applicants must indicate in answer to question 1 of Form 1312 in which engineering special subject they desire to be examined. The vacancies to be filled in the junior engineer grade are in three distinct lines of employment: (1) For testing structural materials, for which an educational groundwork corresponding to the degree of civil engineer or B. S. in civil engineering should qualify the applicant; (2) for testing fuels, for which an educational groundwork corresponding to the degree of mechanical engineer or B. S. in mechanical engineering should qualify the applicant; and (3) for the investigation in the field of methods of mining and production of fuels and structural materials and related subjects, for which an educational groundwork corresponding to the degree of mining engineering or B. S. in mining and engineering should qualify the applicant.

PERSONALS.

K. G. Dunn of Hunt, Mirk & Company has returned from the Northwest.

Samuel Storrow of Los Angeles is in New York City on professional business.

J. M. Hunt of Hunt, Mirk & Company, left last week for the East to be gone about six week.

Jas. D. Schuyler, consulting engineer of Los Angeles, has just returned from a professional trip to Colorado.

S. L. Shuffleton, electrical engineer with the Seattle office of Stone & Webster, has returned to Seattle from Boston.

H. C. Rice, vice president of the General Incandescent Lamp Company of Cleveland, Ohio, arrived in San Francisco this week from Los Angeles.

A. B. Saurman, Pacific Coast manager of the Standard Underground Cable Company is among those recently elected associate members of the A. I. E. E.

R. F. Hayward, formerly manager of the Mexican Light & Power Company, is now manager of the Vancouver Light & Power Company, Vancouver, B. C.

Rudolph Van Norden, consulting engineer Union Trust Building, San Francisco, has been transferred to the grade of member in the American Institute of Electrical Engineers.

Fred T. Mumma, superintendent of the Big Bend power house of the Great Western Power Company, has been elected an associate member of the American Institute of Electrical Engineers.

Guy H. Gibbs, who has been with the Westinghouse Electric & Manufacturing Company for the past eight years, four of which have been with that company's Cincinnati office, is now with the Western Electric Company at Cincinnati.

I. B. Adams, acting superintendent Colgate power division of the Pacific Gas & Electric Company has been elected an associate member of the American Institute of Electrical Engineers, as has also H. A. Laidlaw of the operating and maintenance department of the same company.

E. C. Sornborger has become identified with Allis-Chalmers Company as sales engineer in its pumping engine and hydaulic turbine department. Mr. Sornborger received his early training and practical experience in the shops of the United States Navy, where he was later appointed a cadet engineer. Shortly after he was enlisted in the merchant service as assistant engineer, in which position he remained for a number of years. His subsequent work was with the Buffalo Steam Pump Company, Gordon Steam Pump Company and the Snow Steam Pump Works.

In addition to those above mentioned, the following Pacific Coast engineers were recently elected associate members of th American Institute of Electrical Engineers: W. C. Chappell, British Columbia Electric Railway Company, Ltd.; residence, 1631 Robson street, Vancouver, B. C. A. W. Cochran, electrical engineer, Oregonian Publishing Company; residence, 627 Fifth street, Portland, Ore. R. E. Gude, Davis, Cal. C. M. Hoag, chief operator, Division Creek power plants, Los Angeles Aqueduct, Independence, Cal. G. H. Hoppin, electrician on construction work, Washington Water Power Company, Reardon, Wash. M. C. Lord, electrical machinist, electric department, United States Navy Yard, Vallejo, Cal. A. S. Moody, electrical engineer, General Electric Company, 609 Colman Building, Seattle, Wash. G. O. Noble, sales engineer, Westinghouse Electric & Manufacturing Company; residence, 527 South Main street, Los Angeles. G. W. Porter, tester, Pacific Telephone and Telegraph Company, Seattle, Wash. J. A. Parker, 1171 Tenth street, San Diego, Cal. E. R. Shepard, instructor in physics and electrical engineering, Oregon Agricultural College, Corvallis, Ore. W. R. Vick, general superintendent the Merchants' Mutual Electric Light & Power Company, Santa Barbara, Cal. L. R. Woodcock, switchboard operator, construction camp, Washington Water Power Company, Reardon, Wash.

LOS ANGELES SECTION A. I. E. E.

This section held its first business session of the year on Tuesday, October 26th. The executive committee having secured a suitable down town meeting place in the Blanchard Building, has stimulated the attendance greatly. At this meeting there was an attendance of eighty-two members and visitors. Mr. Clem. A. Copeland read a very interesting paper on "The Life Hazard and Resuscitation in Electrical Engineering." The paper brought out many points, which have seldom been touched upon by any investigator in this line. Dr. Milbank Johnson, Director of the Pacific Mutual Life Insurance Company; Dr. H. C. Stinchfield, chief surgeon for the Southern California Edison Company, were present and participated in a very lively discussion. E. R. Northmore, J. A. Lighthipe, F. P. Walton, R. H. Manahan took part in the engineering end of the discussion.

TRADE NOTES.

Sanderson & Porter have moved from 901 to 907 Union Trust Building, San Francisco.

Hunt, Dillman, Meredith & Allen have moved their offices to the fifth floor of the Union Trust Building, San Francisco.

The Engineering Department of the General Electric Company, San Francisco, have moved to rooms 901-2-3-4-5 of the Union Trust Building.

The Western Gas Engine Company of Los Angeles is installing a 500 h. p. plant for power and lighting in Maricopa, Ariz., consisting of Nix-Frost crude oil suction gas producer and tandem double action gas engine.

The Sheffield Gas Power Company of Kansas City has purchased the factory, assets and good will formerly owned by the Weber Gas Engine Company.

The Electrical Specialties Company of Seattle, P. L. Hoadley, manager, have moved to the new Seattle Syndicate building, 524 First avenue south, where the warehouse, show rooms and offices will be on the same floor.

Horticulture in California is to be the subject of several papers to be read at the twelfth semi-annual meeting of the Counties Committee of The California Promotion Committee, which will be held Saturday, November 13, 1909, at Visalia.

The Phelps-Dodge Company have ordered 2-ATB.-4-750 k. w. 1800 r. p. m., 2300 volt, 60 cycle Curtis turbo generator sets to be operated by the old Dominion Copper Mining & Smelting Company in Arizona. These sets are mixed pressure sets for operation normally on 10 pounds absolute pressure and 3 inches absolute back pressure and they can be operated on live steam of 125 pounds pressure.

The General Electric Company have received an order from the Standard Lumber Company of Deer Park, Wash., for one ATB-2-500 k. w. 3600 r. p. m., 480 volt, horizontal Curtis turbo-generator set for operation on 120 pounds pressure with two inches absolute back pressure and one CC.-2-25 k. w. 3600 r. p. m. 125 volt, compound wound horizontal non-condensing Curtis turbo generator set to be used as an exciter for the alternator.

Allis-Chalmers Company is receiving numerous orders for transformers from some of the large electric companies on the Pacific Coast, including the Great Western Power Company, of San Francisco; the Pacific Gas & Electric Company, San Francisco; the Bear Lake Power Company, Montpelier, Ida.; Portland Railway, Light & Power Company, Portland, Ore.; the Sacramento Valley Power Company, and the Los Angeles Gas & Electric Company. These transformers vary in size from 200 k. w. to 1500 k. w. and for the most part are of the oil filled water cooled type.

NEWS OF THE STATIONARY ENGINEERS.

PREAMBLE.—This Association shall at no time be used for the furtherance of strikes, or for the purpose of interfering in any way between its members and their employers in regard to wages; recognizing the identity of interests between employer and employe, and not countenancing any project or enterprise that will interfere with perfect harmony between them.

Neither shall it be used for political or religious purposes. Its meetings shall be devoted to the business of the Association, and at all times preference shall be given to the education of engineers, and to securing the enactment of engineers' license laws in order to prevent the destruction of life and property in the generation and transmission of steam as a motive power.

California.

No. 1. San Francisco. Thursday, Central Hall, 124 Fulton St. Pres., A. C. Arbuckle. Sec., Herman Noethig, 900 York St.

No. 2. Los Angeles. Friday, Eagles' Hall, 116½ E. Third St. Pres., J. F. Connell. Fin. Sec., Harry Notthoff, 1307 Winfield St. Cor. Sec., W. T. W. Curl, 4103 Dalton Ave.

No. 3. San Francisco. Wednesday, Merchants' Exchange Bldg. Sec., David Thomas, 914 O'Farrell St.

No. 5. Santa Barbara. Geo. W. Stevens, 2417 Fletcher Ave., R. R. No. 2.

No. 6. San Jose. Wednesday. Pres., W. A. Wilson, Sec., Lea Davis, 350 N. 9th St.

No. 7. Fresno. Pres., A. G. Rose. Sec., E. F. Fitzgerald, Box 651.

No. 8. Stockton. Thursday, Masonic Hall. Sec., S. Bunch, 626 E. Channel St. Pres., H. Eberhard.

Oregon.

No. 1. Portland. Wednesday, J. D. Asher, Portland Hotel. Pres., B. W. Slocum.

No. 2. Salem. A. L. Brown, Box 166.

Washington.

No. 2. Tacoma. Friday, 913½ Tacoma Ave. Pres., Geo. E. Bowman. Sec., Thos. L. Keeley, 3727 Ferdinand St., N., Whitworth Sta.

No. 4. Spokane. Tuesday. Pres., Frank Teed. Sec., J. Thos. Greeley, 0601½ Cincinnati St.

No. 6. Seattle. Saturday, 1420 2d Ave. Pres., H. R. Leigh. Sec., J. C. Miller, 1600 Yesler Way.

Practical letters from engineers and news items of general interest are always welcome. Write your items regardless of style. Communications should be addressed to the Steam Engineering Editor.

CALIFORNIA NO. 3.

At the meeting of Cal. No. 3 Mr. A. Broman was initiated and at the conclusion of the routine business the subject brought up for discussion was "The work developed, and the diagrams corresponding to this work," of a wet air pump, connected to a condenser and maintaining a vacuum of 27 inches. Several of the members had worked out theoretical diagrams, and others had on hand actual diagrams, taken at their own plants, the comparison of the two provoked considerable discussion, which brought out opinions which were of much value to the members.

On Wednesday evening, November 3d, R. F. Chevalier, an expert on combustion tests, gave a lecture on "Flue Gas Analysis," illustrating his remarks by a practical demonstration with flue gas taken from the furnaces of the plant at the Merchants' Exchange Building.

Question: A piston valve 5 in. in diameter was found to be worn .21 in diameter. What amount of steam would leak through per hour at 135 lbs. gauge pressure?

Answer: Area of 5 in. circle 19,635 sq. in.
Area of 4.98 in. circle 19,478 sq. in.

Difference.....157 sq. in. area of opening .01 in. wide around a 5 in piston valve.

"Napiers Rule."

Pounds steam per second equals $\frac{P\,a}{70}$

Where P equals pressure absolute and a equals area of opening. In this question 135 lbs. gauge is taken as 150 lbs. absolute. Therefore 150 times 157 equals 23-55 and dividing this by 70 we have .3364 lbs. steam per second from one end of the piston valve and for both ends we would have twice this or .6728 lbs. per second and 60 times this for one minute or 40.368 lbs. for one hour, 60 times this, or 2422.08 lbs. and at the rate of 30 lbs. per h. p. per hour this would equal 80.7 h. p. hours. These figures are for an unobstructed flow of steam and as we have data for such a small opening. and realizing there would be great retardation we have arbitrarily reduced these figures 20 per cent, giving 1937.57 lbs steam per hour or 64.56 h. p. hours.

George F. Bauerlin, president of Oregon No. 3, N. A. S. E., died suddenly at his home in Salem on October 17, from rheumatism of the heart. Mr. Bauerlin was the main stay and life of the Salem Association and his loss will be materially felt. He was serving his second year as president of this association and was elected by a unanimous vote as delegate to the last convention, but owing to business duties was unable to attend. At the time of his death, and for a past number of years, he held the position of chief engineer of the Portland Railway, Light & Power Company and was also superintendent of their gas plant at Salem. Ever ready to lend a helping hand to anyone in distress was one of the virtues of George F. Bauerlin.

BOILER COMPOUNDS.

The necessity of a compound which will remove scale, prevent pitting and corrosion in boilers, is of course well known to all steam users. Not only does a good compound prolong the life of the boiler, but it effects a great saving in fuel and repair.

The heat-conducting power of scale compound to that of iron, is about one to twenty-five; a scale one-eighth of an inch thick requires about 10 per cent more fuel to keep up the right amount of steam at a given h. p. developed than does a clean boiler. When a thick scale is present the iron must be heated to a much greater temperature. If the scale was one-fourth of an inch thick the plates would have to be heated to about 600 deg. F. in order to bring the steam to the same working pressure as in a boiler that was clean.

When iron is kept at this high temperature, it oxidizes and carbonizes; that is, becomes cast iron in places. We then have a weakened boiler. The material is changed and the thickness diminished. The life of the boiler is shortened and extensive repairs are often required or may cause an explosion and the loss of one or more lives.

H, L. GASKILL.

NEW CATALOGUES.

The Sprague Electric Company is sending out an attractive pamphlet, No. 233, which calls attention to its line of electric hoists, shovels, winches, etc.

The Standard Electrical Works of San Francisco are distributing an attractive catalogue from the Jandus Electric Company entitled "Jandus Luxolabra for the City Beautiful." It is divided into three sections, devoted respectively to pressed steel, castiron and concrete lamp standards for city illumination. The illustrations of the pressed steel, pressed copper and pressed bronze standards, with a tapered and fluted column, are especially ornamental.

The Kellogg Switchboard & Supply Company have recently issued a new bulletin (No. 49), on Toll Test Panels, which are a great convenience, as well as a necessity in the operation of an up-to-date toll equipment in connection with a city local exchange. In this bulletin the uses of the different types are fully explained and illustrated, and a detailed description of the construction is given. A more recent bulletin (No. 51) covers the subject of arresters. The different uses for arresters are fully explained and illustrations, accompanied by detailed description, are plentifully scattered through the bulletin. Code numbers are arranged for the different types to facilitate ordering. Brief directions for installing and connecting the arresters, illustrated by diagrams, are also contained in this bulletin.

INDUSTRIAL

SEABOARD AIR LINE ADOPTS THE TELEPHONE FOR TRAIN DISPATCHING.

The Seaboard Air Line has recently completed the installation of a telephone train dispatching circuit between Raleigh and Monroe, North Carolina, a distance of 148 miles. This equipment was cut into service on September 4th, and has been giving excellent service continuously since that time. W. F. Williams, superintendent of telegraph of the Seaboard Air Line, who has been an earnest advocate of the telephone since its use was first proposed for train dispatching, has personally superintended the selection and installation of this equipment, and largely to his efforts is due the excellence in construction of the line and installation of the apparatus.

The portion of the road selected by the Seaboard officials for the first telephone circuit is located between Raleigh and Monroe, the dispatcher's office, being located at Hamlet, 53 miles from Monroe and 95 miles from Raleigh. This portion of the road is single track and carries a heavy traffic, being on the main trunk line to the South.

Fig. 1. Train Dispatcher's Equipment.

Between Raleigh and Hamlet there are 19 selector stations and two siding telephones. Between Hamlet and Monroe there are 10 selector stations.

The line is constructed of No. 9 B. & S. gauge hard drawn copper wire, 210 lbs., per mile. Twenty-inch soft copper tie wires are used and all joints are made by means of copper sleeves. The wires are transposed regularly every one-fourth mile. On the section between Hamlet and Monroe the line is carried on a cross-arm, while on the section between Raleigh and Hamlet the line is carried on brackets attached to opposite sides of the pole just beneath the lower cross-arm. Where the line is carried on crossarms the transpositions are made by means of the Pierce drop bracket, the idea being that in case of a broken insulator there will always be the crossarm between the two wires. Where the line is carried on brackets the transposition is accomplished by raising the brackets on one side and lowering them on the other for a distance of two poles, which provides ample clearance for the transposition.

The telephone and terminal apparatus was furnished by the Western Electric Company, their new high efficiency transmission circuit arrangement being used throughout. The signalling is done by means of Gill main line bridging selectors.

The dispatcher's telephone equipment consists of three sets of head receivers and breast transmitters with cord and plug attached, one set for the use of each trick dispatcher. Fig. 1 illustrates the method of using these sets. This cut is from a photograph taken of one of the dispatchers and the desk equipment at Hamlet. The sending cabinet, it will be noted, is equipped with Gill individual call keys, one for each way station. A pair of jacks is mounted in the front rail of the desk into which the plug connected to the dispatcher's telephone set is inserted.

A key is provided for closing the dispatcher's transmitter battery circuit and is so arranged that the circuit may be held closed while talking only, or locked close, as desired. Portable storage batteries of four volts and 60 ampere hour capacity are used for the dispatcher's transmitter battery. There are two sets of these, one being in service while the other is being charged.

The chief dispatcher's desk is provided with a standard

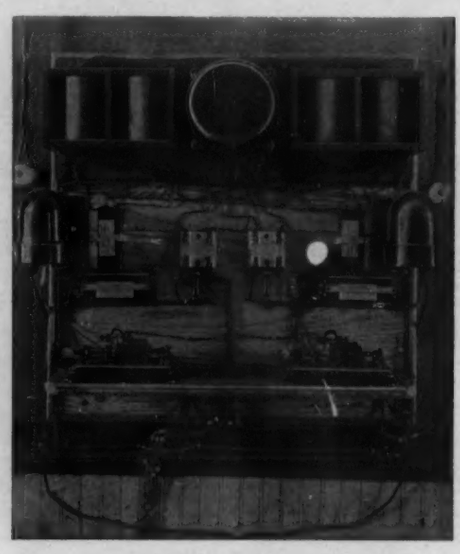


Fig. 2. Method of Mounting Terminal Apparatus.

desk stand telephone, which, however, has asscciated apparatus designed specially to give good transmitting and receiving and still not interfere in any way with the sending or receiving of the regular dispatcher.

The necessary retardation coils and condensers are provided to absorb the noise produced when sending signals to the way station selectors. This is necessary in order that transmission and signalling can be carried on simultaneously.

A repeating coil is introduced into the line at the dispatcher's office, which separates the line into two portions. This arrangement allows signalling on either end independent of the other and results in a considerable saving of sending battery. The two ends of the line terminate at the dispatcher's office, on O'Connell lightning arresters, being brought into the office with No. 12 twisted pair B. R. C. wire independent of all cable. Switches are provided just inside of the protectors so that all of the station apparatus can be cut off from the line if desired. Fig. 2 shows the method of mounting the terminal apparatus referred to above.

At the way stations the telephone equipment consists of the "Flexiphone" transmitter arm, equipped with a special switch hook for use with the leather head band receiver, as shown in Fig. 3, together with its associated induction coil, condenser, etc. A small push button key is provided, which, in its normal position, maintains the circuit for listening.

When the operator desires to talk, the push button key is operated. This key is a feature of the Western Electric Company's high efficiency circuit referred to above. Its use is necessary in order to give the best possible transmitting and receiving, especially under the condition where there are a large number of stations which may have receivers in circuit simultaneously.

The Gill selectors at the way stations as stated above, are of the main line bridging type and are wound to 4500 ohms. These selectors are bridged directly across the line. A variable resistance is furnished which is placed in series with the selector winding. This resistance is of a high value near the dispatcher's station, gradually decreasing at successive stations, so that the last station on the line has no resistance. This resistance is used to compensate for the line resistance and line drop in potential, the result being that all selectors receive the same quantity of current, about 8 milliamperes.

On each side of the selector and in series with it are two small retardation coils to protect the selector windings from injury by lightning. The "answer-back" is produced inductively between the line winding and a low winding in series with the bell and selector contact.

The method of bringing in the leads at the way stations

Fig. 3. Way Station Equipment.

is similar to that at the dispatcher's station. O'Connell protectors being used in all cases. No fuses are used in protecting the line or apparatus, inasmuch as the line is not liable to cross with any high tension circuit.

At two blind sidings between Raleigh and Hamlet are located wall telephones in weatherproof boxes attached to telegraph poles. These boxes are covered with galvanized sheet iron and have a line switch so arranged that the switch must be opened before the door can be closed. These sets are equipped with the high efficiency transmission circuit and apparatus similar to that at the way stations. No ringers are provided as it will not be necessary to ring these stations, and hand generators are omitted since the dispatcher is on the line at all times.

Two portable telephones are furnished for use on wreck cars. These telephones have a hand set, with the necessary associated apparatus for talking and listening, and also a ringer, for use in case the dispatcher wishes to call the wreck car while the set is in service. An 18-foot line pole is furnished with each portable set, this being in three sections of 6 feet each. One hundred feet of flexible conductor is provided with each pole.

At intervals of about 25 miles, a set of test switches are installed, these being located at Wadesboro, Sanford and Aberdeen. There are three switches, one of which opens the circuit to the station apparatus, the others open the line either way, leaving the station apparatus connected to the end of the line not opened. No provision is made for grounding, or short circuiting, as it is not thought that these operations will be much used when testing.

The movement of trains on this section of the road operated by the telephone circuit is assisted by the use of a telephone block system. Between Monroe and Hamlet with ten intervening stations there is in service a special composite block telephone system. This was designed by the Western Electric Company and is a modification of its railway composite telephone. It is used on a local telegraph wire and both telegraph and telephone may be used simultaneously. Between Hamlet and Norlina, 154 miles, is a magneto telephone block system of 36 stations operating on a grounded block wire.

As stated above, the dispatching telephone circuit has been in operation since September 4th. The business of the road on this division has been handled during that time in a manner very satisfactory to the officials of the company. The dispatchers and operators have adapted themselves very readily to the new method and find that they can handle the work with greater ease and dispatch than by the telegraph. Mr. H. W. Purvis, the chief dispatcher at Hamlet, states that he is very well satisfied with the new arrangement, and that his dispatchers are finding the telephone method a great improvement. One of the prominent officials of the road, when asked for his opinion of the telephone, judging from its operation so far, replied that he would like to see every mile of the Seaboard Air Line equipped with the telephone at once.

TUNGSTEN SHOCK ABSORBER.

The popularity of the tungsten incandescent lamp for shop lighting has led to the demand for a device which would successfully counteract the shocks unavoidable in a shop and thus prolong the life of the lamp.

This demand has led to the marketing of numerous so-called shock absorbers, among which may be named the Benjamin tungsten shock absorber, illustrated herewith, manufactured by the Benjamin Manufacturing Company, Chicago, Ill.

This shock absorber consists primarily of a strap wire stirrup with a circular opening in which is located a bushing tapped to receive the fixture stem. This bushing is set

Benjamin Shock Absorber.

into a square metal washer at the top which bears on a coiled spring. This compression spring forms a resilient connection between the stationary element and the fixture. The stirrup has two feet provided with screw holes for attaching to the supporting surface, and when so attached takes the place of an ordinary crowfoot. An additional strap centrally threaded to fit a three-eighths-inch insulating joint is attached to the stirrup by the means of two screws. This strap may be omitted for attaching to a wooden ceiling or block. In one case the device becomes a shock absorbing hickey; in the other, a shock absorbing crowfoot.

Where it is desired to use a brass casing and canopy, a

canopy support consisting of seven-eights-inch brass tubing with the upper end flanged outwardly passes through the opening in the bottom of the stirrup and surrounds the bushing. This permits the canopy to be attached by means of a seven-eights-inch slip ring to the supporting element, thus leaving the fixture with its stem free to move in a vertical plane. There is also enough play between the movable parts to allow the fixture to hang plumb even though the support might be uneven.

On either side of the stirrup are located machine screws, the purpose of which is to keep the bushing from being displaced. These screws, however, can be removed and the device taken apart for the purpose of changing the springs, or for removing or inserting the canopy support which should be finished to correspond with the fixture.

The device is furnished with one of three springs varying in stiffness to correspond to the weight of the fixture with which the absorber is to be used. The light spring will hold a fixture from one to four pounds, the medium, from four to ten pounds, and the heavier from ten to sixteen pounds.

The shock absorber meets one of the fundamental requirements of the successful devices of this character in that provision is made for locating it at the ceiling or point of the fixture support rather than above the individual lamp sockets. The greater weight and consequent greater inertia of the former lessens the liability of the lamps to shock from sudden jars, from which more filaments are broken by vibrations from above than from accidental shocks from below. By use of this shock absorber short, quick vibrations at the ceiling or support are not transmitted to any part of the fixture except the top directly attached.

ELECTRICALLY HEATED OIL TEMPERING BATH.

The oil tempering bath is very largely used by manufacturers for the purpose of tempering steel tools or dies. It has been common practice to heat the bath by gas; but as very close regulation of temperature is essential for a uniform quality of product, gas heating has not proved satisfactory. Added to this is the ever present fire hazard due to the excessive heat possible when gas is used.

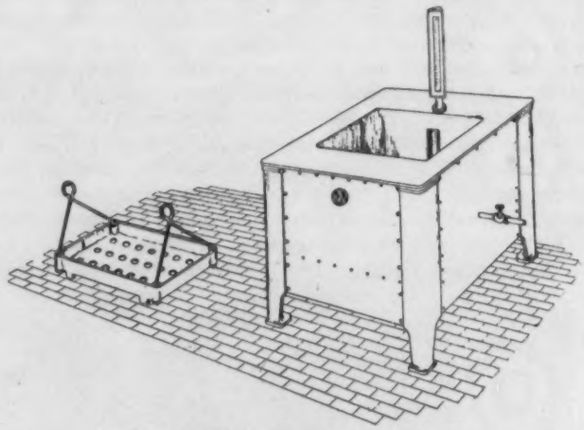
As is often the case, the use of electricity has been advocated as a solution of the problem of proper oil tempering; and the General Electric Company has recently perfected an electrically heated oil bath which seems to meet all the requirements of such apparatus. The general appearance of this device is shown in the illustration.

The bath proper consists of a cast iron tank, or pot, having twelve lugs evenly spaced around the sides. These lugs are drilled to receive standard cartridge units, and it is found by thus distributing the units that an even temperature can be maintained in all parts of the oil. Around the pot is placed a heat retaining jacket consisting of an inner and outer wall of sheet metal, the space of three inches between the walls being filled with mineral wool. The jacketing on each side of the pot is easily removable, thus allowing quick access to the internal connections of the units. Around the top of the pot there is a wide flange to which are secured four (4) cast iron legs. A drain pipe controlled by a globe valve provides a means for drawing off the oil. There is a protected recess in one end of the pot, in which a thermometer can be placed to indicate the temperature of the oil.

There are two methods of using the oil bath. In the first method the temperature of the oil is raised to about 250 degrees F., the work placed in the bath and full heat turned on. When the oil reaches the desired temperature, the work is removed and the current turned off. This method requires a single heat bath. The second method is to turn on full heat, bring the oil to the desired temperature, then introduce the work, and by means of regulating switches maintain that temperature constant any length of time desired.

Where desired, a cast iron basket or tray is supplied in which the work can be placed. The basket has eye bolts at each end to facilitate handling. The bottom of the basket is perforated with ⅞-inch holes permitting free circulation of the oil. There are also legs on the bottom of the basket which keep the work an inch or more above the bottom of the bath.

The heating units are connected in groups according to the size of the bath, and the leads are brought out to the terminal block. In the single heat devices, each group is protected by a fuse. In the multiple heat device, the leads are carried to the switchboard, the latter being so arranged that the energy input can be varied in small steps from zero to maximum. A switchboard is not necessary for the single heat bath, but is required where a multiple heat device is wanted.



Electrically Heated Oil Tempering Bath.

Any desired temperature is obtained by throwing in the necessary number of units to give the approximate value. Close regulation is then secured by varying the voltage impressed on one of the units. This is accomplished by means of the rheostat mounted on the board. As a result of this method, there is a negligible loss of energy in the regulating device.

The inside dimensions, weight, oil capacity and energy consumption of the three sizes in which the bath is made are as follows:

	Length.	Width.	Depth.	Weight.	Oil.	Kilowatts.
No. 1	22 ins.	12 ins.	8 ins.	420 lbs.	9 gals.	6
No. 2	18 ins.	12 ins.	12 ins.	475 lbs.	11 gals.	7.2
No. 3	30 ins.	16 ins.	18 ins.	900 lbs.	37 gals.	20

The energy consumption is sufficient to heat the oil to a temperature of 450 degrees F. in less than one hour, starting cold.

TRADE NOTES.

The territory of the Los Angeles office of the Westinghouse Electric & Manufacturing Company has been extended to include southern New Mexico, eastern Texas and northern and western Mexico. A branch office has been established at El Paso with D. W. Beldon, formerly manager of the Electric Light Company at Phoenix, Ariz., in charge.

At the Denver street railway convention Dossert & Company, New York, exhibited a new mechanical connector for use in making tap-offs from aluminum feeder cables to copper branches. The connector is similar to the standard Dossert cable tap with the exception that the hook part of of the connector is cast in aluminum while the shank is cast in copper and supplied with copper sleeve and compression nut, thus giving contact of aluminum to aluminum and copper to copper. Otis & Squires, 155 New Montgomery street, San Francisco, Cal., who are the Pacific Coast representatives of Dossert & Company carry a large stock of these connectors.

NEWS NOTES

FNANCIAL.

CONCULLY, WASH.—The bond issue of $5500 for the construction of a water system has carried.

COTTAGE GROVE, ORE.—The bond issue of $150,000 for installation of a water system for the city has carried.

PAYETTE, IDAHO.—The City Council has passed an ordinance providing for an election to vote on the question of the issuance of bonds for the installation of water and sewer systems.

RENTON, WASH.—The city of Renton at an election to be held December 7, will vote on the question of issuing bonds in the sum of $12,000 to secure funds for the completion of the municipal water system, work upon which has been commenced.

PROSSER, WASH.—The voters of the city of Prosser will be given a chance to vote either on putting in an entire new pipe water system at an estimated cost of $25,703.02, or of voting to buy the old system and putting in the extensions which the estimated cost will be $9,419.18.

RIVERSIDE, CAL.—The City Council has passed an ordinance providing for issuing bonds for the amount of $115,000, of which $110,000 will be used to erect a municipal building and $5000 for construction of a reservoir and water pipes and hydrants in connection therewith, on Arlington Heights.

TRANSMISSION.

KINGMAN, ARIZ.—The Frisno Mines Power Company, operating near Kingman, Ariz., will install an electric power plant on its property.

EUGENE, ORE.—The county court has granted a franchise to the city for the transmission line from the hydro-electric power plant to the city.

INDEPENDENCE, CAL.—J. E. Elbeshutz has been granted permission to construct and operate a system of power lines upon the public highways.

SHOSHONE, IDAHO.—The Great Shoshone & Twin Falls Water Power Company has been granted a right of way over various county roads of Lincoln county .

NELSON, B. C.—The Bull River Falls Power & Light Company is building at Fort Steele an immense flume that will provide 10,000 horsepower at lowest water.

RENO, NEV.—The Reno Power, Light & Water Company will construct a $1,000,000 plant west of Reno, on the Truckee River, in order to increase the power furnished by the company.

COLFAX, WASH.—The Palouse Power & Irrigation Company has purchased a private site and will erect a dam for the purpose of watering several thousand acres near Washtucna.

OAKLAND, CAL.—An ordinance granting to the Great Western Power Company a franchise to operate in this city for the sale of electricity for light, heat and power, has been adopted by the City Council.

EVERETT, WASH.—The Snohomish Electric Company has been incorporated for $200,000, by J. E. Weikstrom. The company will probably take over the local lighting system and probably make extensive improvements.

ZILLAH, WASH.—C. H. Furman announces that it is practically assured that a power transmission line will be placed across from the main line of the Yakima Valley Power Company to supply about 80 horsepower in this place.

MARYSVILLE, CAL.—The work of construction on the new electric power line between this city and Meridian, in Sutter County, a distance of 20 miles, has been started and will be hurried to completion as rapidly as possible.

ENTIAT, WASH.—Charles Gray and associates have purchased the Gullage tract of 225 acres at the mouth of the Entiat and will put in a dam and erect a power plant to furnish power for the electric line from Douglas to Waterville.

FOLSOM, CAL.—The Great Western Power Company has men at work constructing a power line along the Sacramento-Folsom road from its sub-station near Dredge. The line is primarily for the purpose of supplying power to the Natomas Consolidatded.

WALLA WALLA, WASH.—A large power plant is being constructed on the south fork of the Walla Walla river by the interests behind the Columbia and Walla Walla Traction Company, for the purpose of furnishing power to the Dayton-Wallula electric line.

METALINE, WASH.—Sullivan lake is to be made 10 feet deeper. A dam is to be thrown across its outlet preparatory to building a $300,000 cement plant. The lake is 14 miles long, and the company must pay the government $25,000 for the timber which stands on the lands that will be flooded. A 10,000 horsepower plant will be developed at the dam.

OAKLAND, CAL.—Unsightly telephone poles and wires are fast disappearing in the business district in compliance with the ordinance requiring the placing of wires underground in established districts. Nearly all of its poles on Broadway, Telegraph and San Pablo avenues as far as Twentieth street and on Franklin street have been removed by the Oakland Gas, Light and Heat Company. The three established districts in which poles and wires have been removed comprise the section between Sevnth and Seventeenth streets, Washington street and Broadway, inclusive, and Franklin street, between Eleventh and Fourteenth, The next underground district will be established April 1st next, calling for the removal of wires and poles on Franklin streets, between Seventh and Fourteenth; Seventh, Eighth, Ninth, Tenth and Eleventh streets, between between Broadway and Franklin; on Twelfth street, between Franklin and First avenue; on Eleventh and Thirteenth streets, from the east side of Franklin street to the west line of Webster. The seventh district will be establishd four years hence, excluding poles and providing for underground wires as far west as Jefferson street, north to Twentieth and south to the north side of Third street, where runs the Western Pacific Company's tracks. The extension of the underground districts eastward will be taken up later.

TELEPHONE.

MEDFORD, ORE.—A telephone franchise has been granted to C. E. Sharpe.

QUINCY, WASH.—Grant County Telephone Co. has been incorporated by T. O. Yeldel.

BUTTE, MONT.—The interstate Consolidated Telephone Co. has been incorporated for $5,000,000 by Herbert L. Risley.

SHOSHONE, IDA.—The Southern Idaho Telephone Company has been granted a franchise over the various county roads of Lincoln county.

WALLOWA, ORE.—The Home Telephone Company will start work at once on a line to Lower Valley. The company will also copper circuit the main line from Le Grande to Joseph.

KAMLOOPS, B. C.—The Board of Trade is working in conjunction with the B. C. Telephone Company to secure telephone communication with many of the outlying points as well as with coast cities.

MISSOULA, MONT.—The Montana Independent Telephone Company has bought the Bitter Root Telephone Company, which extends from Corvalis to Darby. This line will be extended to Victor and Florence.

DILLON, MONT.—The Montana Independent Telephone Company is preparing to install its system here. The company will also build cross-country lines from Butte to Twin Bridges, Sheridan and Virginia City to connect with Dillon.

CRESCENT CITY, CAL.—The poles for the new telephone line from Harner to Crescent City are up most to the city limits. Mr. W. J. Cooley of Harbor spent several days here during the week on business connected with the telephone company.

ILLUMINATION.

LOS ANGELES, CAL.—The Board of Public Works has decided that Sunset Boulevard shall be well lighted.

EUREKA, CAL.—The Eureka Electrical Company of this city has been awarded a contract to install a lighting plant on Willow Creek near China Flat for a mining company of Los Angeles.

SEATTLE, WASH.—An ordinance has been passed providing for the improvement of Jackson street from Railroad avenue to Fourteenth avenue south, by the installation of a system of cluster lights along the curb line.

NAPA, CAL.—The directors of the Veterans' Home at Yountville have contracted with the Snow Mountain Power Company for the furnishing of the big institution with electricty for lighting and power purposes.

LONG BEACH, CAL.—Members of the Board of Public Works are planning to light Bixby Park with strings of incandescents, which will greatly add to the beauty of the spot. Arc lights are to be put in for each block along Ocean avenue.

SAN FRANCISCO, CAL.—Word has been received from the war department granting the request that gas be piped from the plant of the San Francisco Gas Company to the Presidio general hospital. Work on the installation will begin at once.

PORTLAND, ORE.—The property owners on Sixth street have formed an organization under the name of the Sixth Street Improvement Association, for the purpose of establishing a system of lighting posts on Sixth street from John son to Jefferson streets.

EUGENE, ORE.—The deal which has been pending between the Howard Electric Company of Eugene and the Willamette Valley Company has been consummated and in a short time the Willamette Valley Company will take over the plant at this place.

TRANSPORTATION.

TACOMA, WASH.—Municipal ownership of street railways will probably be submitted to the voters at the next election.

FRESNO, CAL.—F. S. Granger has been awarded a franchise in the city for the Fresno-Hanford interurban electric railroad.

FRESNO, CAL.—F. S. Granger, promoter of the Fresno-Hanford interurban electric road has been awarded his franchise in this city.

ONTARIO, CAL.—The City Council will receive sealed bids up to December 14th for an electric railroad franchise over certain streets in this city.

BERKELEY, CAL.—The Southern Pacific has been begun construction work on its double track electric ferry line from San Pablo avenue eastward to the Santa Fe.

PETALUMA, CAL.—The Highland Pacific Railroad is procuring rights of way from Lakeport via Cloverdale to Santa Rosa to operate an electric line over this district.

PASADENA, CAL.—Surveyors are active on Huntington lines between South Pasadena and Eastlake Park for a projected third line between Pasadena and Los Angeles.

TACOMA, WASH.—J. W. Diefendorff and associates are considering the project of constructing an electric railway to Mount Rainier by way of Spanaway and Ohop lakes.

LOS ANGELES, CAL.—A committee has been appointed to confer with the Pacific Electric Railway Company in reference to the raising of the railroad tracks on Mission road, near Rose Hill avenue.

BOISE, IDA.—The City Council has under consideration the granting of a franchise for a new suburban trolley line which eastern and local capital represented by Dean Perkins will build between Boise and Kuna.

VANCOUVER, B. C.—The management of the B. C. electric railway has let the contract for the initial work on the proposed extensions of the company in Lynn valley on the north side of the inlet to the Patterson Timber Company.

SAN FRANCISCO, CAL.—The second step in the rebuilding of the Geary street railway as a municipal line has been taken by the Supervisors. The bill calls upon the city engineer for an estimate of the cost of construction. It is planned to hold the election authorizing a bond issue early in December.

MARYSVILLE, CAL.—At a special meeting of the Council the Northern Electric Company was denied an application for a franchise to operate trains over Orange street. The company has been operating over this thoroughfare for the last two years on a temporary permit, but as it has expired the Council will cause the removal of the tracks.

HANFORD, CAL.—H. P. Brown of this city has received notice from F. S. Granger, who says: "I have just closed for the sale of $625,000 of the bonds, and will leave for Chicago tonight to close for the balance." Mr. Granger left Fresno a few days ago for the East on the mission of financing his Fresno-Hanford interurban line, for which he has recently secured renewed franchises in Fresno city and county. He will return within a few weeks.

MEDFORD, ORE.—John R. Allen of New York, owner of the Pacific & Eastern Railway, will apply to the City Council here for an electric railway franchise. He will also ask franchise of a similar nature in Ashland and Grants Pass and it is reported that he will build electric lines to connect all points in the Rogue River Valley. He has formed a syndicate known as the Southern Oregon Railways Company, capitalized at $1,500,000, and claims he will begin building as soon as the franchises are obtained.

EUREKA, CAL.--George Henderson, who built the Eureka Street Railway System has returned from San Francisco and says: "I am back in Eureka for the purpose of building a railroad out of the city. I come with the backing necessary to carry out the plan and in a few days will ask the City Council to grant my people a franchise through the city from some point on the waterfront. I will ask the council to make it a condition that all bidders for the franchise offered for sale shall deposit a forfeit of $25,000. In connection with this road which will have electricity for its motive power a power plant will be installed and a big sawmill will be built. We shall ask the council to require all bidders on the franchise to bid on a road carrying not less than 60-pound steel."